4.3 TRAFFIC AND CIRCULATION

This section describes potential impacts on automobile, bicycle, and pedestrian traffic at the Ames Campus and in the local study area from the implementation of the NASA Ames Development Plan.

A. Standards of Significance

An alternative for the NASA Ames Development Plan would have significant impact with respect to traffic and circulation if it would result in:

- Increased vehicle trips or traffic congestion - the methodologies used to assess this impact follow those described in *Transportation Impact Analysis Guidelines* produced by the Santa Clara Valley Transportation Authority (VTA) as part of its Congestion Management Program (CMP), as well as City of Mountain View and Sunnyvale guidelines. The indicator of significant impact varies by facility type as summarized in Table 4.3-1.
- Insufficient parking capacity on-site or off-site.
- Hazards to safety from design features (e.g., sharp curves or dangerous intersections) or incompatible uses.
- Inadequate emergency access or access to nearby uses.
- Hazards or barriers for pedestrians or bicyclists.
- Conflicts with policies supporting alternative transportation (e.g. bus turnouts, bicycle racks).
- Alterations to rail, waterborne, or air travel modes.

B. Impact Discussion

Implementation of the NADP would increase the demand for transportation infrastructure and services both within the project area and the region. The transportation component of the NADP includes improvements for the circulation system within the Ames Campus, as well as strategies to minimize

TABLE 4.3-1 **TRAFFIC CONGESTION IMPACT CRITERIA**

Affected Agency	**Cumulative Operations** Without the Project	**Significant Impact Occurs if the Project:**
Signalized Intersections		
Mountain View and Sunnyvale (Local)	LOS D or better	Degrades operations to LOS E or F.
	LOS E or F	Increases the critical delay by four or more seconds and increases the critical V/C ratio by 0.01 or more OR Causes a decrease in the critical delay, but increases the critical V/C ratio by 0.01 or more.
Sunnyvale (Local) only[1]	LOS A, B or C	Causes an intersection to degrade to a lower level (e.g., LOS B to C, LOS C to D)
CMP	LOS E or better	Degrades operations to LOS F.
	LOS F	Increases the critical delay by four or more seconds and increases the critical V/C ratio by 0.01 or more OR Causes a decrease in the critical delay, but increases the critical V/C ratio by 0.01 or more.
Unsignalized Intersections		
All jurisdictions	LOS D or better	Degrades to LOS E or F, and causes intersection to meet or exacerbate peak hour signal warrant criteria
Freeway Segments		
All jurisdictions	LOS F[2]	Increases volume by more than one percent of capacity

Note: "+" and "-" designations for intersection LOS identify ranges of delay. A "+" indicates that the intersection is on the better end of the range for a particular LOS, with shorter delays, while a "-" indicates that the intersection is on the worse end of the range for a particular LOS.

[1] The City of Sunnyvale examines all changes in LOS grade (e.g., LOS C to C-) to determine if minor improvements can be implemented to minimize even less than significant impacts.
[2] Since future cumulative freeway levels of service beyond five (5) years are difficult to predict, the impact to freeway segments is considered *potentially* significant if the existing LOS is E or F.

or mitigate impacts on the regionally-significant and local facilities that provide access to the Center.

1. Effects on Roadways

The amount of traffic distributed to the study roadways was estimated using the three-step process of: 1) trip generation, 2) trip distribution, and 3) trip assignment. This process is described below, followed by an analysis of impacts on local and regional roadways.

a. Trip Generation

In the first step in the forecasting process, the number of new trips generated by each of the proposed development alternatives is calculated by applying trip generation rates for the different land use types proposed within the four planning areas. The trip generation rates used in this study were taken from the Institute of Transportation Engineer's (ITE's) *Trip Generation* (Sixth Edition), with the following exceptions and clarifications:

- **The California Air and Space Center Museum and Exhibit Space, and the Computer History Museum.** Rates for this type of use are not included in the *Trip Generation* manual. Therefore, project-specific rates were developed using information from several existing aerospace and science museums, and the expected operating hours, staffing levels, and daily attendance.
- **University Uses.** The proposed university uses would include educational facilities for resident and "commuter" students including extension classes. Facilities would include dry labs, teaching labs, and classrooms plus administrative offices for faculty and staff. Under all alternatives, the total University-designated square meters (square footage) was assumed to include 58 percent classroom and lab space and 42 percent office uses based on input from representatives of the University California at Santa Cruz. ITE rates were used for each of these uses, respectively.
- **Student Apartments and Dormitories.** In the University area, student apartments and dormitories would be provided to students, faculty, and staff. Each unit is expected to house two persons. Since these individuals

would all be affiliated with the University uses, their travel behavior would be unlike that of typical apartment dwellers because they would have more flexible schedules and would tend to generate more trips. Accordingly, the gross trip rate used for these units (1.28 to 1.50 trips per unit) is actually higher than that of a typical single-family residence (1.0 per unit), and more than double the industry standard apartment rate of 0.51 to 0.60 trips per unit in the peak hour. For this analysis, 65 percent of persons are assumed to travel during the peak hour. A majority (75 percent) of these trips are assumed to be via foot, bike or shuttle to uses within the Ames Campus area.

— **Townhome and Apartment Units.** Housing on-site would be medium- to high-density multi-family in nature, and would only be available to on-site employees, faculty or students. The majority of travel made by these individuals during the peak period would generally be completed within Moffett Field and would involve fewer home-based work trips than typical apartment residents because of the Center's internal shuttle service (see discussion of on-site housing reductions on the following page). On-site employees and students in townhome and apartment units may or may not have a spouse and/or family members. For this use, 75 percent of on-site employees were assumed to travel during the peak hour. In addition, the trip rate was increased to account for working spouses, of which 50 percent were assumed to travel during the peak hour. Because of these assumptions, the resulting gross trip rate for townhomes and apartments is 1.15 to 1.35 trips per unit during the peak hour, which is more than double the industry standard townhouse/condominium rate of 0.54 trips per unit and higher than the standard rate of 1.0 trips per unit for a single-family residence. Sixty-five percent of these trips are assumed to made within the campus area by foot, bike or shuttle.

— **Conference and Training Center.** No standard trip rates are available for this type of use. Trip rates were estimated based on the estimated number of outside daytime users and overnight guests, NRP and Ames Campus users, length of stay, and mode of transportation (i.e., rental car, taxi or public transit).

— **Disaster Training Facility**. No standard trip rates are available for this type of use. Rates were estimated based on the number of dormitory-style beds and the number of individuals expected to be on-site.

The resulting rates were used to calculate a gross number of daily, AM and PM peak hour trips based on the square meters (square footage), number of rooms, number of students, or dwelling units for each of the different proposed land use types within the four planning areas. The specific trip generation rates and resulting gross trips used for this analysis are shown in Appendix B.

The initial gross trip generation estimates were reduced to account for the proposed implementation of an aggressive TDM program, the provision of on-site amenities, and the effect of on-site housing where at least one resident is required to work or attend class at the Ames Research Center. As described in Chapter 2, the TDM program would include charging for parking, which is one of the most effective tools in encouraging the use of alternative travel modes. Local shuttle service would run to and from the VTA light rail and Caltrain stations, and would allow residents to travel to and from their work site without using a vehicle. All tenants will be required to comply with the TDM program.

A housing reduction was applied to account for on-site employment requirements and the typical proportion of work trips made during the peak commute periods. On-site uses such as child care, as well as amenities including bank machines, fitness centers, restaurants, etc. are also expected to result in reduced trip rates for employees and on-site residents. During the peak periods, the number of gross vehicle trips for each housing area was reduced by either 65 or 75 percent depending on the housing type (see descriptions above). This reduction represents persons traveling between a residence and an on-site employment/university location via a non-automobile mode. An equivalent reduction was proportionately applied to each employment/university location to account for trips made by on-site residents via shuttle, bicycling, or walking. In addition to parking costs

within the NRP serving as a disincentive to driving, the provision of on-site amenities would reduce the need for on-site residents to drive to off-site locations to obtain some services. A daily on-site housing reduction of 35 percent was estimated based on the amount of travel usually associated with work trips.

A reduction was replied to the remaining vehicle trips (gross trips minus housing reductions) to account for the effect of an extensive TDM program. As described in Chapter 2, the TDM program would include charging for parking, which is one of the most effective tools in encouraging the use of alternative travel modes, frequent shuttle service and other provisions. Local shuttle service would run to and from the VTA light rail and Caltrain stations, and would allow residents to travel to and from their work site without using a vehicle. Working spouses or roommates of on-site residents would be able to use these amenities to reduce their overall vehicle trip-making. All tenants would be required to comply with the TDM program, which is expected to result in a 22 percent trip reduction compared to typical commute patterns for Santa Clara County employees.[1] NASA already achieves a 17 percent reduction at the Ames Research Center without the major components of the proposed project's TDM program.

A summary of the trip generation for each plan area under each alternative is shown in Tables 4.3-2 through 4.3-5. A comparison of the project trip generation calculations for all alternatives, and including the Mitigated Alternative 5, is shown in Table 4.3-5A. These trips would be in addition to the future cumulative trips generated by baseline projects in Alternative 1 and shown in Table 3.3-8.

[1] Source:"*Commute Profile 2000, A Survey of Bay Area Commute Patterns*" conducted by RIDES for Bay Area Commuters.

b. Trip Distribution

The second step consists of forecasting the travel direction of project-generated trips by assigning trips to specific transportation facilities on the basis of trip distribution percentages. The trip distribution was estimated based on two sources: 1) data provided by MTC showing the residence of employees in the Sunnyvale-Mountain View area for Year 2000 through 2020, and 2) the City of Mountain View traffic model. The MTC data was used to establish the regional distribution of trips on major highways in the South Bay Area (Highways 101, 237, 85, 280, 680, and 880), while the Mountain View model was used to better approximate the amount of traffic on arterial roadways in the immediate project area. Figure 4.3-1 shows the distribution of project trips within the immediate study area.

c. Trip Assignment

The final step of this process is to assign project trips to specific roadways based on the trip distribution described above and the turning movements at each intersection. This assignment was performed using the TRAFFIX model, which was ultimately used to calculate intersection LOS. Project-only volumes are illustrated on Figures 4.3-2 through 4.3-5 for Alternatives 2 through 5, respectively. It is important to note that the intensity of proposed land uses changes locations between alternatives (e.g., some have more density in the NRP, while others include extensive development in Bay View). Thus, volumes at a given intersection under an alternative may be higher than those for another alternative, even though the first alternative generates a lower number of total daily or peak hour trips.

d. Impacts on Intersection Operations

The project volumes generated by each alternative were added to the Future Cumulative No Project volumes shown in Section 3.3 and the LOS was re-calculated for each location. The results of the Future Cumulative Plus Project Conditions analysis is presented in Tables 4.3-6 through 4.3-9 for Alternatives 2 through 5, respectively. Besides showing the projected LOS at each intersection without and with the proposed project, these tables include the change in critical delay and the change in the critical volume-to-capacity

TABLE 4.3-2 **PROJECT TRIP GENERATION SUMMARY - ALTERNATIVE 2**

	Trips						
		AM			PM		
	Daily	In	Out	Total	In	Out	Total
Bay View Total	9,209	886	363	1,249	396	888	1,285
On-site Housing Reduction	-1,371	-137	-188	-325	-206	-176	-382
TDM Trip Reductions	-1,724	-165	-38	-203	-42	-157	-199
Net Bay View Trips	6,114	584	137	721	148	555	704
Eastside/Airfield Total	8,366	578	114	692	138	539	677
On-site Housing Reduction	-648	-129	-25	-154	-59	-121	-180
TDM Trip Reductions	-463	-27	-5	-32	-5	-25	-30
Net Eastside/Airfield Trips	7,255	422	84	506	74	393	467
Ames Campus Total	0	0	0	0	0	0	0
On-site Housing Reduction	0	0	0	0	0	0	0
TDM Trip Reductions	0	0	0	0	0	0	0
Net Ames Campus Trips	0	0	0	0	0	0	0
NRP Total	15,919	1,181	707	1,888	792	1,672	2,464
On-site Housing Reduction	-2,971	-326	-379	-704	-429	-398	-826
TDM Trip Reductions	-3,872	-340	-85	-425	-100	-419	-520
Net NRP Trips	9,076	515	243	759	263	855	1,118
Total Net Trips	**22,445**	**1,521**	**464**	**1,986**	**485**	**1,803**	**2,289**

Note: A standard TDM reduction of 22 percent was applied to all areas except the Eastside/Airfield, where a TDM reduction of 6 percent was applied. The TDM reduction for the NRP area may appear to be higher than 22 percent; however, this is caused by the increased on-site housing reduction provided by the already approved uses in the NASA Research Park under the CUP (i.e., some CUP employees will live in the on-site housing). A review of the detailed trip generation estimates included in the appendix illustrates all of the reductions.

TABLE 4.3-3 **PROJECT TRIP GENERATION SUMMARY - ALTERNATIVE 3**

	Trips						
		AM			PM		
	Daily	In	Out	Total	In	Out	Total
Bay View Total	0	0	0	0	0	0	0
On-site Housing Reduction	0	0	0	0	0	0	0
TDM Trip Reductions	0	0	0	0	0	0	0
Net Bay View Trips	0	0	0	0	0	0	0
Eastside/Airfield Total	3,220	287	63	350	83	263	346
On-site Housing Reduction	-208	-43	-8	-51	-20	-40	-60
TDM Trip Reductions	-181	-15	-3	-18	-4	-13	-17
Net Eastside/Airfield Trips	2,831	229	51	281	60	210	269
Ames Campus Total	0	0	0	0	0	0	0
On-site Housing Reduction	0	0	0	0	0	0	0
TDM Trip Reductions	0	0	0	0	0	0	0
Net Ames Campus Trips	0	0	0	0	0	0	0
NRP Total	21,153	1,872	817	2,689	991	2,556	3,548
On-site Housing Reduction	-3,092	-362	-397	-758	-455	-435	-890
TDM Trip Reductions	-4,997	-484	-106	-590	-139	-606	-744
Net NRP Trips	13,064	1,026	314	1,341	457	1,515	1,914
Total Net Trips	**15,895**	**1,255**	**365**	**1,622**	**517**	**1,725**	**2,183**

Note: A standard TDM reduction of 22 percent was applied to all areas except the Eastside/Airfield, where a TDM reduction of 6 percent was applied. The TDM reduction for the NRP area may appear to be higher than 22 percent; however, this is caused by the increased on-site housing reduction provided by the already approved uses in the NASA Research Park under the CUP (i.e., some CUP employees will live in the on-site housing). A review of the detailed trip generation estimates included in the appendix illustrates all of the reductions.

TABLE 4.3-4 **PROJECT TRIP GENERATION SUMMARY - ALTERNATIVE 4**

	Trips						
		AM			PM		
	Daily	In	Out	Total	In	Out	Total
Bay View Total	19,123	1,887	793	2,680	877	2,093	2,969
On-site Housing Reduction	-2,980	-286	-402	-688	-438	-370	-808
TDM Trip Reductions	-3,551	-352	-86	-438	-97	-379	-476
Net Bay View Trips	12,592	1,249	305	1,554	342	1,344	1,686
Eastside/Airfield Total	9,244	707	132	839	162	656	818
On-site Housing Reduction	-750	-146	-28	-173	-67	-136	-203
TDM Trip Reductions	-510	-34	-6	-40	-6	-31	-37
Net Eastside/Airfield Trips	7,984	528	98	625	89	489	577
Ames Campus Total	0	0	0	0	0	0	0
On-site Housing Reduction	0	0	0	0	0	0	0
TDM Trip Reductions	0	0	0	0	0	0	0
Net Ames Campus Trips	0	0	0	0	0	0	0
NRP Total	12,748	898	544	1,442	608	1,309	1,917
On-site Housing Reduction	-2,457	-283	-285	-568	-334	-332	-666
TDM Trip Reductions	-3,287	-287	-70	-357	-81	-354	-435
Net NRP Trips	7,004	328	189	517	193	623	816
Total Net Trips	**27,580**	**2,105**	**592**	**2,696**	**624**	**2,456**	**3,079**

Note: A standard TDM reduction of 22 percent was applied to all areas except the Eastside/Airfield, where a TDM reduction of 6 percent was applied. The TDM reduction for the NRP area may appear to be higher than 22 percent; however, this is caused by the increased on-site housing reduction provided by the already approved uses in the NASA Research Park under the CUP (i.e., some CUP employees will live in the on-site housing). A review of the detailed trip generation estimates included in the appendix illustrates all of the reductions.

TABLE 4.3-5 **PROJECT TRIP GENERATION SUMMARY - ALTERNATIVE 5**

	Trips						
		AM			PM		
	Daily	In	Out	Total	In	Out	Total
Bay View Total	7,245	138	725	863	678	334	1,013
On-site Housing Reduction	-2,536	-97	-508	-605	-476	-234	-710
TDM Trip Reductions	-1,036	-9	-48	-57	-45	-22	-67
Net Bay View Trips	3,673	32	169	201	157	78	236
Eastside/Airfield Total	0	0	0	0	0	0	0
On-site Housing Reduction	0	0	0	0	0	0	0
TDM Trip Reductions	0	0	0	0	0	0	0
Net Eastside/Airfield Trips	0	0	0	0	0	0	0
Ames Campus Total	3,850	461	95	556	76	432	508
On-site Housing Reduction	-600	-120	-23	-143	-55	-113	-168
TDM Trip Reductions	-715	-75	-16	-91	-5	-70	-75
Net Ames Campus Trips	2,535	266	56	322	16	249	265
NRP Total	15,668	1,217	552	1,768	659	1,798	2,457
On-site Housing Reduction	-3,897	-622	-308	-930	-453	-638	-1,091
TDM Trip Reductions	-3,613	-282	-67	-349	-66	-394	-460
Net NRP Trips	8,158	313	177	489	140	766	906
Total Net Trips	**14,366**	**611**	**402**	**1,012**	**313**	**1,093**	**1,407**

Note: A standard TDM reduction of 22 percent was applied to all areas except the Eastside/Airfield, where a TDM reduction of 6 percent was applied. The TDM reduction for the NRP area may appear to be higher than 22 percent; however, this is caused by the increased on-site housing reduction provided by the already approved uses in the NASA Research Park under the CUP (i.e., some CUP employees will live in the on-site housing). A review of the detailed trip generation estimates included in the appendix illustrates all of the reductions.

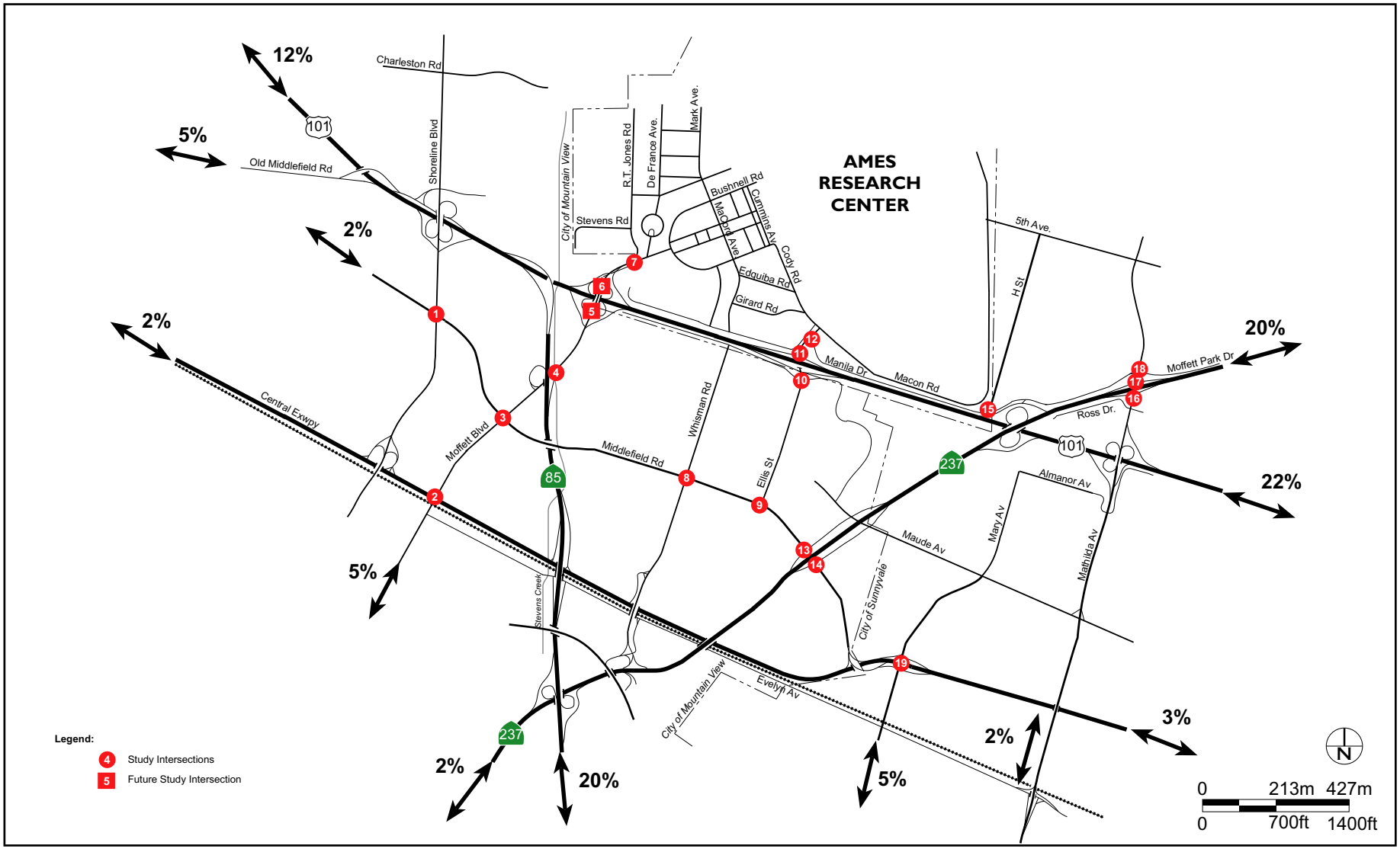
TABLE 4.3-5A **COMPARISON OF PROJECT TRIP GENERATION SUMMARY - ALL ALTERNATIVES**

	Total Net New Trips						
		AM			PM		
	Daily	In	Out	Total	In	Out	Total
Alternative 1 (No Project)	5,584	827	72	899	112	759	871
Alternative 2	22,455	1,521	464	1,986	485	1,803	2,289
Alternative 3	15,895	1,255	365	1,622	517	1,725	2,183
Alternative 4	27,580	2,105	592	2,696	624	2,456	3,079
Alternative 5	14,366	611	402	1,012	313	1,093	1,407
Mitigated Alternative 5*	14,880	-46	476	430	266	543	785

* For more information on Mitigated Alternative 5 trips, see Section 5.3.

(V/C) ratio. For the two unsignalized intersections (Moffett Boulevard/Clark Memorial Drive at R.T. Jones Road, and Ellis Street at Manila Drive), it should be noted that the data in the table represents the change in average control delay because of the different study methodology.

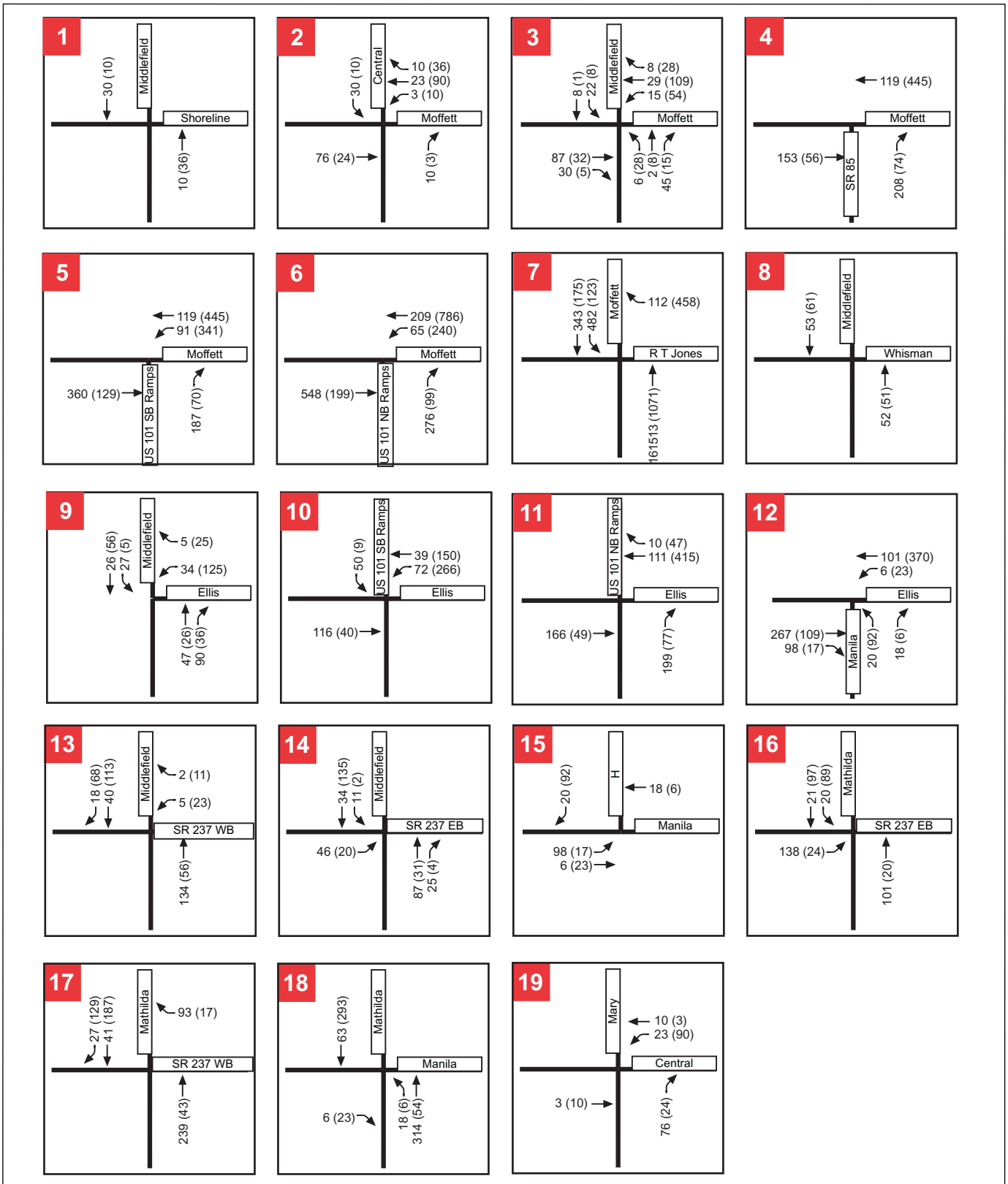
The results in Tables 4.3-6 through 4.3-9 show that implementation of the proposed project would cause varying numbers of study intersections to operate at unacceptable levels during the AM and/or PM peak hour. Under the Preferred Alternative (Alternative 5), one intersection would operate at unacceptable levels in both the AM and PM peak hour. Under Alternatives 2 and 3, seven intersections would operate at unacceptable levels in either or both the AM and PM peak hours. Under Alternative 4, there would be ten such intersections. Both unsignalized intersections are projected to experience excessive delay without installation of a traffic signal or changes to the existing lane configurations.



Source: Fehr & Peers Associates, Inc.

FIGURE 4.3-1

PROJECT TRIP DISTRIBUTION



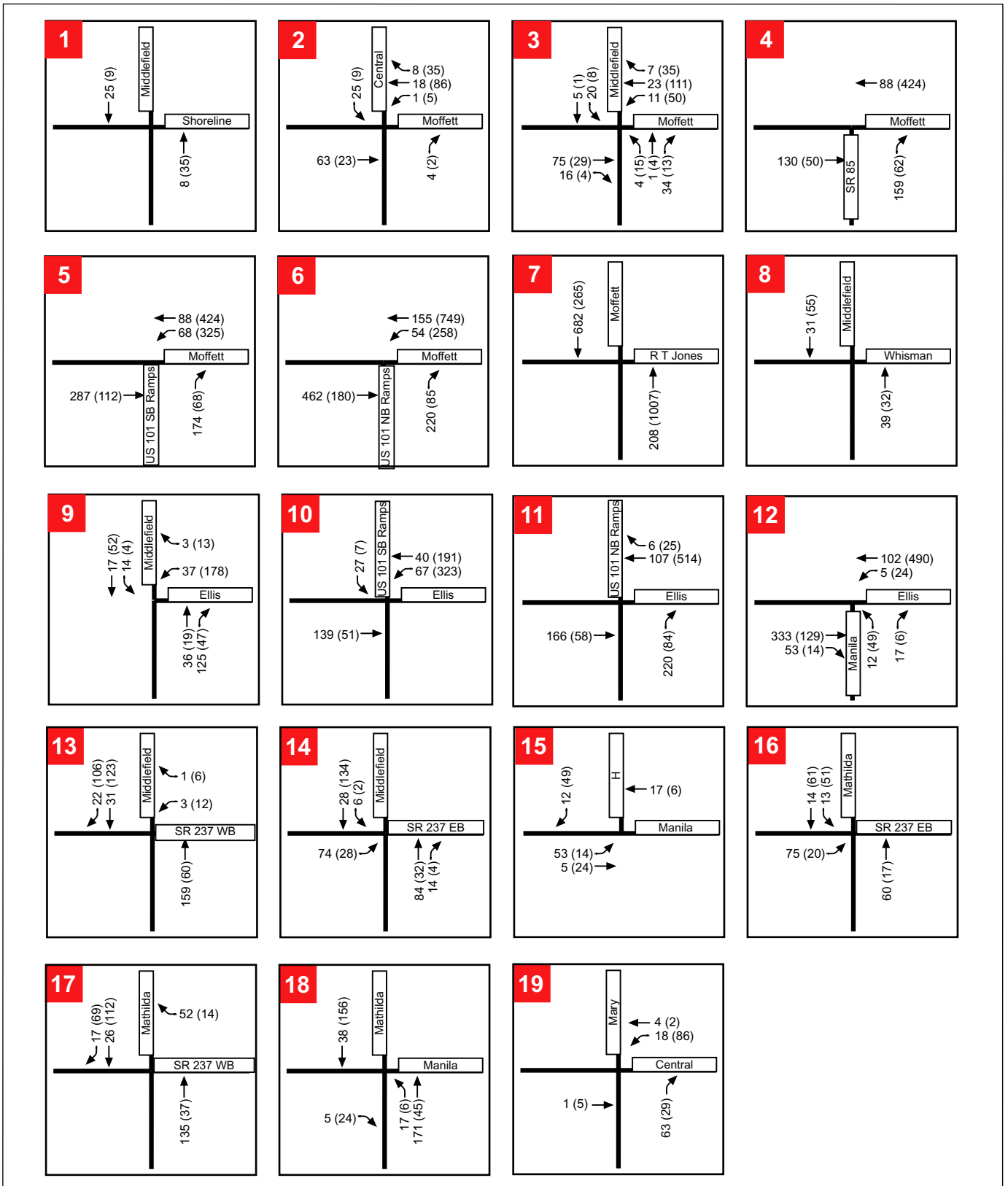
not to scale

Source: Fehr & Peers Associates, Inc.

XX (YY) = AM (PM)
Peak Hour
Traffic Volumes

FIGURE 4.3-2

PROJECT TRIP ASSIGNMENT
ALTERNATIVE 2



not to scale

Source: Fehr & Peers Associates, Inc.

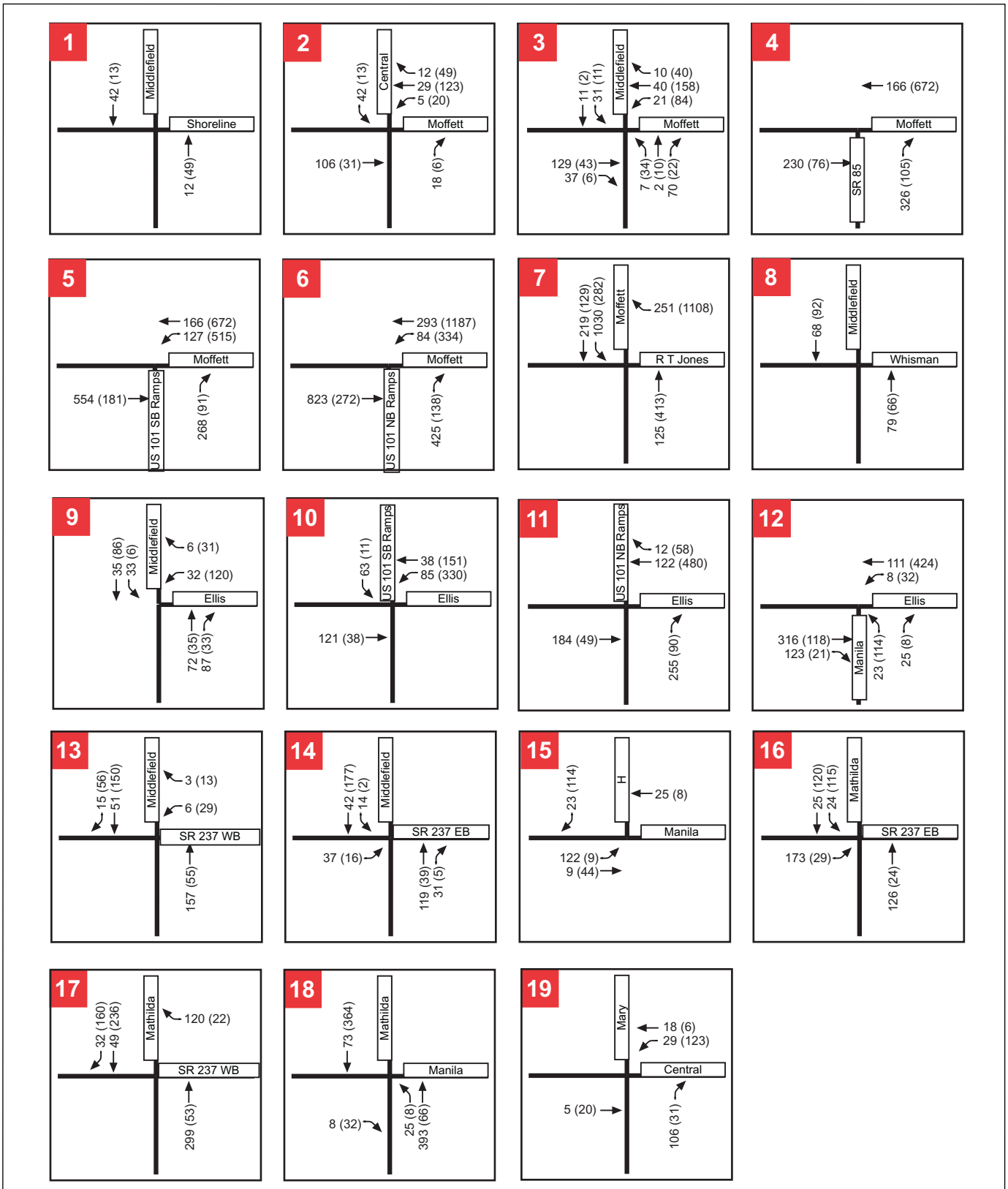
XX (YY) = AM (PM)
Peak Hour
Traffic Volumes

FIGURE 4.3-3

PROJECT TRIP ASSIGNMENT
ALTERNATIVE 3

NASA AMES RESEARCH CENTER

NASA AMES DEVELOPMENT PLAN FINAL EIS



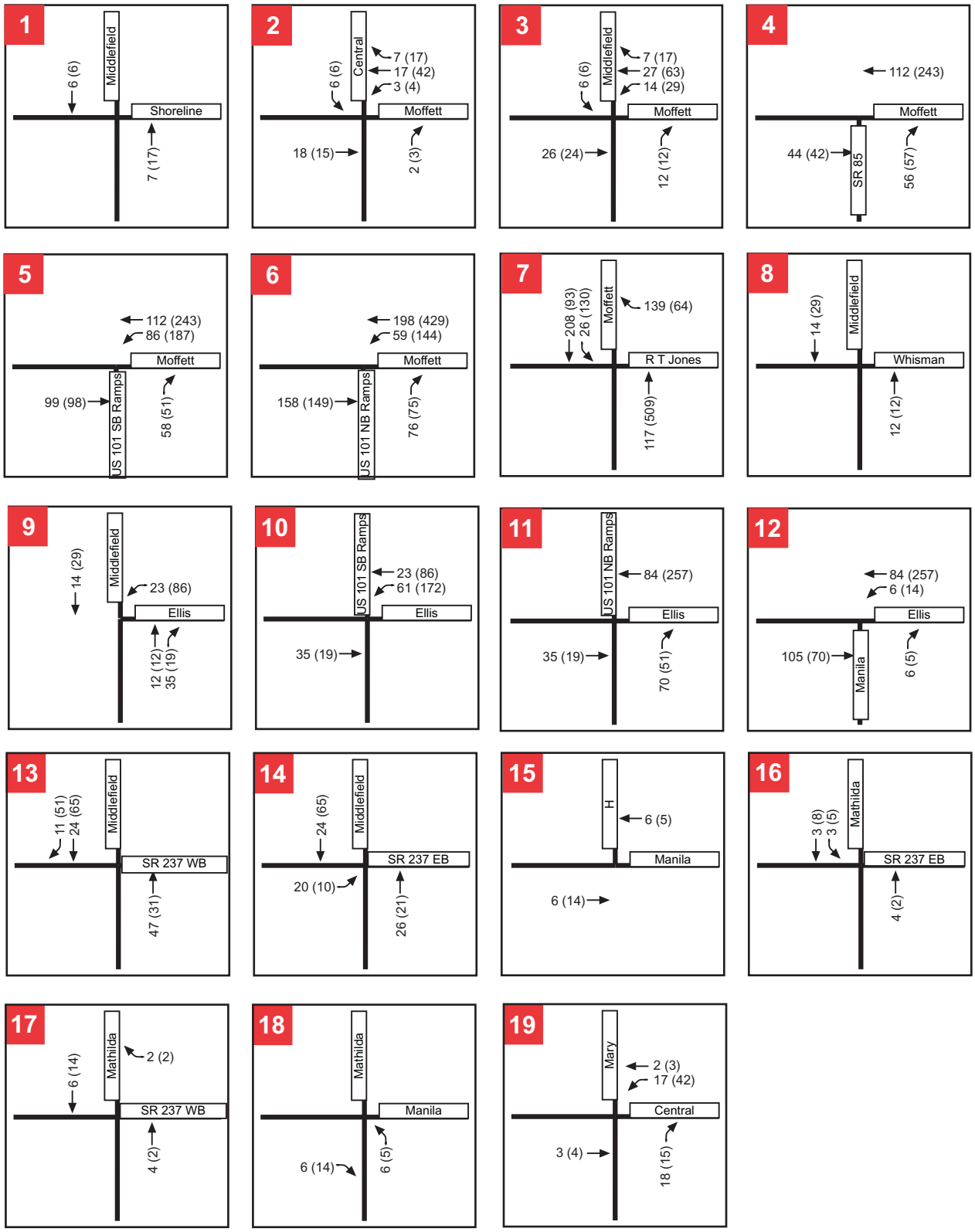
not to scale

Source: Fehr & Peers Associates, Inc.

XX (YY) = AM (PM) Peak Hour Traffic Volumes

FIGURE 4.3-4

PROJECT TRIP ASSIGNMENT ALTERNATIVE 4



not to scale

Source: Fehr & Peers Associates, Inc.

XX (YY) = AM (PM)
Peak Hour
Traffic Volumes

FIGURE 4.3-5

PROJECT TRIP ASSIGNMENT
ALTERNATIVE 5

TABLE 4.3-6: **YEAR 2013 CUMULATIVE CONDITIONS WITH AND WITHOUT ALTERNATIVE 2**

Intersection	Peak Hour	Year 2013 Cumulative Without Alternative 2		Year 2013 Cumulative Plus Alternative 2			
		Delay (sec)[1]	LOS[2]	Delay (sec)	LOS	Change in Delay[3]	Change in V/C[4]
Middlefield Road/	AM	*48.5*	*E*	48.6	E	+0.0	+0.000
Shoreline Boulevard	PM	*48.5*	*E*	48.9	E	+0.0	+0.000
Moffett Boulevard/	AM	48.0	E	55.8	E	+10.8	+0.050
Central Expressway	PM	53.4	E	**65.6**	**F**	**+12.2**	**+0.044**
Moffett Boulevard/	AM	36.1	D	**48.5**	**E**	**+21.0**	**+0.089**
Middlefield Road	PM	36.1	D	**43.8**	**E+**	**+10.4**	**+0.054**
Moffett Boulevard/	AM	11.3	B	15.0	C+	+4.7	+0.177
SR 85 NB Ramp	PM	5.6	B+	6.4	B+	+0.2	+0.130
Moffett Boulevard/	AM	10.3	B	16.0	C+	+7.5	+0.308
US 101 SB Ramps	PM	12.1	B	31.6	D	+39.5	+0.269
Moffett Boulevard/	AM	10.6	B	32.2	D	+29.0	+0.433
US 101 NB Ramps	PM	11.2	B	16.8	C+	+1.4	+0.327
Moffett Blvd.(Clark Road)/	AM	*63.8*	*F*	**217.8**	**F**	**+153.9**	**+0.517**
R.T. Jones Road	PM	*196.6*	*F*	**>360**	**F**	**+270.9**	**+0.720**
Whisman Road/	AM	13.6	B-	13.5	B-	-0.1	+0.016
Middlefield Road	PM	15.1	C+	15.0	B-	0.0	+0.018
Ellis Street/	AM	21.6	C	30.4	D	+12.2	+0.070
Middlefield Road	PM	17.2	C	19.5	C	+3.1	+0.066
Ellis Street/	AM	21.3	C	23.5	C-	+1.6	+0.023
US 101 SB Ramps	PM	16.8	C+	20.9	C	+5.5	+0.173
Ellis Street/	AM	18.2	C	18.9	C	+1.0	+0.049
US 101 NB Ramps	PM	11.8	B	11.9	B	-1.3	+0.066
Ellis Street/	AM	10.8	B	14.8	B	+4.0	+0.155
Manila Drive	PM	20.5	C	**53.6**	**F**	**+33.1**	**+0.297**
Middlefield Road/	AM	15.3	C+	15.6	C+	+0.7	+0.041
SR 237 WB Ramps	PM	19.4	C	21.6	C	+6.8	+0.050
Middlefield Road/	AM	19.3	C	19.6	C	+1.0	+0.035
SR 237 EB Ramps	PM	12.7	B	12.4	B	-0.3	+0.040
Manila Drive/	AM	7.1	B	8.1	B	+0.9	+0.077
H Street	PM	11.0	B	11.3	B	+0.5	+0.077
Mathilda Avenue/	AM	*100.5*	*F*	132.1	**F**	**+37.2**	**+0.054**
SR 237 EB Ramps	PM	17.3	C	18.5	C	+3.5	+0.022
Mathilda Avenue/	AM	*284.6*	*F*	**>360**	**F**	**+130.0**	**+0.092**
SR 237 WB Ramps	PM	*> 360*	*F*	**>360**	**F**	**>360**	**+0.080**
Manila Drive (Moffett Park	AM	*> 360*	*F*	**>360**	**F**	**>360**	**+0.063**
Ext.)/Mathilda Avenue	PM	*339.3*	*F*	**>360**	**F**	**+78.6**	**+0.059**
Central Expressway/	AM	*85.6*	*F*	86.5	F	+3.7	+0.009
Mary Avenue	PM	48.6	E	53.7	E	+15.8	+0.055

Note: Unacceptable operations without the project are shown in italics, while significant impacts are highlighted in bold and highlighted text.

[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle (sec/veh) for signalized intersections, and total control delay in sec/veh for unsignalized intersections.
[2] LOS calculations for signalized intersections performed using the 1985 *Highway Capacity Manual* methodology contained in the TRAFFIX software package with adjusted saturation flow rates to reflect local conditions.
[3] LOS calculations for unsignalized intersections performed using the 1997 *Highway Capacity Manual* methodology contained in the TRAFFIX software package.
[4] Change in average critical delay between Background and Project Conditions.
[5] Change in critical volume/capacity (V/C).

TABLE 4.3-7: **YEAR 2013 CUMULATIVE CONDITIONS WITH AND WITHOUT ALTERNATIVE 3**

Intersection	Peak Hour	Year 2013 Cumulative Without Alternative 3 Delay (sec)[1]	Year 2013 Cumulative Without Alternative 3 LOS[2]	Year 2013 Cumulative Plus Alternative 3 Delay (sec)	Year 2013 Cumulative Plus Alternative 3 LOS	Change in Delay[3]	Change in V/C[4]
Middlefield Road/	AM	*48.5*	*E*	48.6	E	+0.0	+0.000
Shoreline Boulevard	PM	*48.5*	*E*	48.9	E	+0.0	+0.000
Moffett Boulevard/	AM	48.0	E	54.2	E	+8.5	+0.041
Central Expressway	PM	53.4	E	**64.9**	**F**	**+11.7**	**+0.042**
Moffett Boulevard/	AM	36.1	D	**45.0**	**E**	**+15.2**	**+0.070**
Middlefield Road	PM	36.1	D	**43.4**	**E+**	**+10.3**	**+0.054**
Moffett Boulevard/	AM	11.3	B	13.7	B-	+3.2	+0.139
SR 85 NB Ramp	PM	5.6	B+	6.2	B+	+0.1	+0.124
Moffett Boulevard/	AM	10.3	B	14.8	B-	+6.0	+0.277
US 101 SB Ramps	PM	12.1	B	28.8	D	+34.1	+0.253
Moffett Boulevard/	AM	10.6	B	21.1	C	+14.6	+0.369
US 101 NB Ramps	PM	11.2	B	16.0	C+	+0.4	+0.315
Moffett Blvd. (Clark Road)/	AM	*63.8*	*F*	**278.4**	**F**	**+214.6**	**+0.748**
R.T. Jones Road	PM	*196.6*	*F*	**>360**	**F**	**>360**	**+1.250**
Whisman Road/	AM	13.6	B-	13.5	B-	-0.1	+0.009
Middlefield Road	PM	15.1	C+	15.0	C+	0.0	+0.016
Ellis Street/	AM	21.6	C	30.3	D	+12.0	+0.070
Middlefield Road	PM	17.2	C	20.4	C	+4.4	+0.085
Ellis Street/	AM	21.3	C	23.5	C-	+1.7	+0.023
US 101 SB Ramps	PM	16.8	C+	22.1	C	+7.3	+0.207
Ellis Street/	AM	18.2	C	18.9	C	+0.9	+0.049
US 101 NB Ramps	PM	11.8	B	11.9	B	-1.2	+0.089
Ellis Street/	AM	10.8	B	14.9	B	+4.1	+0.116
Manila Drive	PM	20.5	C	**49.0**	**E**	**+28.6**	**+0.240**
Middlefield Road/	AM	15.3	C+	15.7	C+	+0.9	+0.047
SR 237 WB Ramps	PM	19.4	C	22.9	C	+10.8	+0.072
Middlefield Road/	AM	19.3	C	19.6	C	+0.9	+0.036
SR 237 EB Ramps	PM	12.7	B	12.4	B	-0.3	+0.039
Manila Drive/	AM	7.1	B	7.7	B	+0.5	+0.046
H Street	PM	11.0	B	11.2	B	+0.3	+0.046
Mathilda Avenue/	AM	*100.5*	*F*	**118.2**	**F**	**+20.9**	**+0.031**
SR 237 EB Ramps	PM	17.3	C	18.2	C	+3.0	+0.014
Mathilda Avenue/	AM	*284.6*	*F*	**339.1**	**F**	**+69.7**	**+0.052**
SR 237 WB Ramps	PM	*>360*	*F*	**>360**	**F**	**>360**	**+0.043**
Manila Drive (Moffett Park	AM	*>360*	*F*	**>360**	**F**	**>360**	**+0.034**
Ext.)/Mathilda Avenue	PM	*339.3*	*F*	**>360**	**F**	**+50.9**	**+0.039**
Central Expressway/	AM	*85.6*	*F*	86.3	F	+3.0	+0.007
Mary Avenue	PM	48.6	E	53.4	E	+15.0	+0.053

Note: Unacceptable operations without the project are shown in italics, while significant impacts are highlighted in bold and highlighted text.

[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle (sec/veh) for signalized intersections, and total control delay in sec/veh for unsignalized intersections.
[2] LOS calculations for signalized intersections performed using the 1985 *Highway Capacity Manual* methodology contained in the TRAFFIX software package with adjusted saturation flow rates to reflect local conditions.
[3] LOS calculations for unsignalized intersections performed using the 1997 *Highway Capacity Manual* methodology contained in the TRAFFIX software package.
[4] Change in average critical delay between Background and Project Conditions.
[5] Change in critical volume/capacity (V/C).

TABLE 4.3-8: **YEAR 2013 CUMULATIVE CONDITIONS WITH AND WITHOUT ALTERNATIVE 4**

		Year 2013 Cumulative Without Alternative 4		Year 2013 Cumulative Plus Alternative 4			
Intersection	Peak Hour	Delay (sec)[1]	LOS[2]	Delay (sec)	LOS	Change in Delay[3]	Change in V/C[4]
Middlefield Road/	AM	*48.5*	*E*	48.6	E	+0.0	+0.000
Shoreline Boulevard	PM	*48.5*	*E*	49.1	E	+0.0	+0.000
Moffett Boulevard/	AM	48.0	E	**59.5**	**E-**	**+16.1**	**+0.069**
Central Expressway	PM	53.4	E	**70.9**	**F**	**+17.5**	**+0.059**
Moffett Boulevard/	AM	36.1	D	**57.6**	**E-**	**+36.4**	**+0.130**
Middlefield Road	PM	36.1	D	**48.6**	**E**	**+16.8**	**+0.078**
Moffett Boulevard/	AM	11.3	B	21.1	C	+13.3	+0.274
SR 85 NB Ramp	PM	5.6	B+	7.3	B	+1.0	+0.196
Moffett Boulevard/	AM	10.3	B	26.4	D+	+20.4	+0.423
US 101 SB Ramps	PM	12.1	B	**66.3**	**F**	**+109.0**	**+0.402**
Moffett Boulevard/	AM	10.6	B	**109.5**	**F**	**+126.4**	**+0.618**
US 101 NB Ramps	PM	11.2	B	35.2	D	+29.5	+0.451
Moffett Blvd. (Clark Road)/	AM	*63.8*	*F*	**>360**	**F**	**+345.1**	**+1.692**
R.T. Jones Road	PM	*196.6*	*F*	**>360**	**F**	**>360**	**+1.855**
Whisman Road/	AM	13.6	B-	13.4	B-	-0.2	+0.020
Middlefield Road	PM	15.1	C+	15.0	B-	0.0	+0.027
Ellis Street/	AM	21.6	C	32.2	D	+14.7	+0.080
Middlefield Road	PM	17.2	C	19.4	C	+3.2	+0.067
Ellis Street/	AM	21.3	C	23.7	C-	+1.6	+0.022
US 101 SB Ramps	PM	16.8	C+	22.7	C	+7.8	+0.214
Ellis Street/	AM	18.2	C	19.0	C	+1.0	+0.055
US 101 NB Ramps	PM	11.8	B	11.9	B	-1.2	+0.089
Ellis Street/	AM	10.8	B	16.2	C	+5.4	+0.194
Manila Drive	PM	20.5	C	**62.9**	**F**	**+42.5**	**+0.351**
Middlefield Road/	AM	15.3	C+	15.7	C+	+0.9	+0.048
SR 237 WB Ramps	PM	19.4	C	21.3	C	+5.7	+0.044
Middlefield Road/	AM	19.3	C	19.6	C	+1.1	+0.036
SR 237 EB Ramps	PM	12.7	B	12.2	B	-0.3	+0.052
Manila Drive/	AM	7.1	B	8.4	B	+1.2	+0.098
H Street	PM	11.0	B	11.4	B	+0.7	+0.096
Mathilda Avenue/	AM	*100.5*	*F*	**140.5**	**F**	**+47.0**	**+0.067**
SR 237 EB Ramps	PM	17.3	C	18.9	C	+3.8	+0.027
Mathilda Avenue/	AM	*284.6*	*F*	**> 360**	**F**	**+170.5**	**+0.118**
SR 237 WB Ramps	PM	*> 360*	*F*	**> 360**	**F**	**> 360**	**+0.100**
Manila Drive (Moffett Park	AM	*> 360*	*F*	**> 360**	**F**	**> 360**	**+0.079**
Ext.)/Mathilda Avenue	PM	*339.3*	*F*	**> 360**	**F**	**+102.1**	**+0.075**
Central Expressway/	AM	*85.6*	*F*	**87.1**	**F**	**5.9**	**+0.012**
Mary Avenue	PM	48.6	E	56.4	E	+23.6	+0.076

Note: Unacceptable operations without the project are shown in italics, while significant impacts are highlighted in bold and highlighted text.

[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle (sec/veh) for signalized intersections, and total control delay in sec/veh for unsignalized intersections.
[2] LOS calculations for signalized intersections performed using the 1985 *Highway Capacity Manual* methodology contained in the TRAFFIX software package with adjusted saturation flow rates to reflect local conditions.
[3] LOS calculations for unsignalized intersections performed using the 1997 *Highway Capacity Manual* methodology contained in the TRAFFIX software package.
[4] Change in average critical delay between Background and Project Conditions.
[5] Change in critical volume/capacity (V/C).

TABLE 4.3-9: **YEAR 2013 CUMULATIVE CONDITIONS WITH AND WITHOUT ALTERNATIVE 5**

Intersection	Peak Hour	Year 2013 Cumulative Without Alternative 5 Delay (sec)[1]	Year 2013 Cumulative Without Alternative 5 LOS[2]	Year 2013 Cumulative Plus Alternative 5 Delay (sec)	Year 2013 Cumulative Plus Alternative 5 LOS	Change in Delay[3]	Change in V/C[4]
Middlefield Road/	AM	*48.5*	*E*	48.5	E	+0.0	+0.000
Shoreline Boulevard	PM	*48.5*	*E*	48.7	E	+0.0	+0.000
Moffett Boulevard/	AM	48.0	E	50.4	E	+2.9	+0.016
Central Expressway	PM	53.4	E	58.9	E-	+5.5	+0.022
Moffett Boulevard/	AM	36.1	D	39.1	D-	+5.3	+0.029
Middlefield Road	PM	36.1	D	39.9	D-	+5.3	+0.032
Moffett Boulevard/	AM	11.3	B	12.5	B	+0.6	+0.043
SR 85 NB Ramp	PM	5.6	B+	6.0	B+	+0.0	+0.071
Moffett Boulevard/	AM	10.3	B	11.2	B	+1.8	+0.088
US 101 SB Ramps	PM	12.1	B	18.4	C	+12.9	+0.156
Moffett Boulevard/	AM	10.6	B	12.2	B	+3.7	+0.178
US 101 NB Ramps	PM	11.2	B	12.5	B	-4.0	+0.216
Moffett Blvd. (Clark Road)/	AM	*63.8*	*F*	**147.5**	**F**	**+83.6**	**+0.355**
R.T. Jones Road	PM	*196.6*	*F*	**382.4**	**F**	**+185.8**	**+0.619**
Whisman Road/	AM	13.6	B-	13.6	B-	0.0	+0.004
Middlefield Road	PM	15.1	C+	15.0	C+	0.0	+0.009
Ellis Street/	AM	21.6	C	23.6	C-	+2.9	+0.022
Middlefield Road	PM	17.2	C	18.5	C	+1.7	+0.040
Ellis Street/	AM	21.3	C	24.3	C-	+0.9	+0.013
US 101 SB Ramps	PM	16.8	C+	19.2	C	+2.9	+0.108
Ellis Street/	AM	18.2	C	18.3	C	+0.1	+0.010
US 101 NB Ramps	PM	11.8	B	12.2	B	-1.4	+0.005
Ellis Street/	AM	10.8	B	11.7	B	+0.9	+0.017
Manila Drive	PM	20.5	C	28.3	D	+7.8	+0.100
Middlefield Road/	AM	15.3	C+	15.4	C+	+0.2	+0.014
SR 237 WB Ramps	PM	19.4	C	20.6	C	+4.0	+0.033
Middlefield Road/	AM	19.3	C	19.3	C	+0.2	+0.005
SR 237 EB Ramps	PM	12.7	B	12.5	B	-0.1	+0.019
Manila Drive/	AM	7.1	B	7.2	B	+0.1	+0.004
H Street	PM	11.0	B	11.0	B	0.0	+0.003
Mathilda Avenue/	AM	*100.5*	*F*	101.7	F	+1.5	+0.002
SR 237 EB Ramps	PM	17.3	C	17.4	C	+0.1	+0.002
Mathilda Avenue/	AM	*284.6*	*F*	286.3	F	+2.3	+0.002
SR 237 WB Ramps	PM	*> 360*	*F*	> 360	F	+334.5	+0.000
Manila Drive (Moffett Park	AM	*> 360*	*F*	> 360	F	0.0	+0.000
Ext.)/Mathilda Avenue	PM	*339.3*	*F*	349.1	F	+11.5	+0.009
Central Expressway/	AM	*85.6*	*F*	85.6	F	+0.8	+0.002
Mary Avenue	PM	48.6	E	50.6	E	+6.5	+0.026

Note: Unacceptable operations without the project are shown in italics, while significant impacts are highlighted in bold and highlighted text.

[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle (sec/veh) for signalized intersections, and total control delay in sec/veh for unsignalized intersections.
[2] LOS calculations for signalized intersections performed using the 1985 *Highway Capacity Manual* methodology contained in the TRAFFIX software package with adjusted saturation flow rates to reflect local conditions.
[3] LOS calculations for unsignalized intersections performed using the 1997 *Highway Capacity Manual* methodology contained in the TRAFFIX software package.
[4] Change in average critical delay between Background and Project Conditions.
[5] Change in critical volume/capacity (V/C).

TABLE 4.3-9A **YEAR 2013 CUMULATIVE CONDITIONS WITH AND WITHOUT THE MITIGATED ALTERNATIVE 5**

		Year 2013 Cumulative Without Alternative 5		Year 2013 Cumulative Plus Alternative 5 w/ Additional Housing		
Intersection	Peak Hour	Delay (sec)[1]	LOS[2]	Delay (sec)	LOS	Change in Delay[3]
Middlefield Road/	AM	*48.5*	*E*	48.5	E	+0.0
Shoreline Boulevard	PM	*48.5*	*E*	48.6	E	+0.0
Moffett Boulevard/	AM	48.0	E	49.1	E	+1.0
Central Expressway	PM	53.4	E	56.7	E-	+3.2
Moffett Boulevard/	AM	36.1	D	36.8	D	+1.0
Middlefield Road	PM	36.1	D	38.2	D-	+3.0
Moffett Boulevard/	AM	11.3	B	11.5	B	+0.2
SR 85 NB Ramp	PM	5.6	B+	5.9	B+	-0.1
Moffett Boulevard/	AM	10.3	B	10.5	B	+2.1
US 101 SB Ramps	PM	12.1	B	15.1	C+	+6.0
Moffett Boulevard/	AM	10.6	B	10.1	B	+1.5
US 101 NB Ramps	PM	11.2	B	11.7	B	-5.1
Moffett Blvd. (Clark	AM	*63.8*	*F*	**73.4**	**F**	**+9.5**
Road)/R.T. Jones Road	PM	*196.6*	*F*	**295.5**	**F**	**+99.1**
Whisman Road/	AM	13.6	B-	13.6	B-	-0.1
Middlefield Road	PM	15.1	C+	15.2	C+	-6.6
Ellis Street/	AM	21.6	C	22.0	C	+0.7
Middlefield Road	PM	17.2	C	17.8	C	+0.8
Ellis Street/	AM	21.3	C	23.4	C-	+1.2
US 101 SB Ramps	PM	16.8	C+	18.0	C	+1.4
Ellis Street/	AM	18.2	C	18.3	C	-0.1
US 101 NB Ramps	PM	11.8	B	12.1	B	+0.2
Ellis Street/	AM	10.8	B	10.9	B	+0.1
Manila Drive	PM	20.5	C	24.4	C	+4.0
Middlefield Road/	AM	15.3	C+	15.3	C+	-0.1
SR 237 WB Ramps	PM	19.4	C	19.9	C	+1.6
Middlefield Road/	AM	19.3	C	19.1	C	+0.0
SR 237 EB Ramps	PM	12.7	B	12.6	B	- 0.1
Manila Drive/	AM	7.1	B	7.1	B	0.0
H Street	PM	11.0	B	11.0	B	0.0
Mathilda Avenue/	AM	*100.5*	*F*	101.9	F	+1.5
SR 237 EB Ramps	PM	17.3	C	17.4	C	+0.0
Mathilda Avenue/	AM	*284.6*	*F*	283.6	F	-1.0
SR 237 WB Ramps	PM	*> 360*	*F*	> 360	F	+167.5
Manila Drive (Moffett Park	AM	*> 360*	*F*	> 360	F	0.0
Ext.)/Mathilda Avenue	PM	*339.3*	*F*	344.3	F	+5.7
Central Expressway/	AM	*67.2*	*F*	66.9	F	-0.3
Mary Avenue	PM	52.2	E	55.0	E	+7.8

Note: Unacceptable operations without the project are shown in italics, while significant impacts are highlighted in bold and highlighted text.

[1] Whole intersection weighted average stopped delay expressed in seconds per vehicle (sec/veh) for signalized intersections, and total control delay in sec/veh for unsignalized intersections.
[2] LOS calculations for signalized intersections performed using the 1985 *Highway Capacity Manual* methodology contained in the TRAFFIX software package with adjusted saturation flow rates to reflect local conditions.
[3] LOS calculations for unsignalized intersections performed using the 1997 *Highway Capacity Manual* methodology contained in the TRAFFIX software package.
[4] Change in average critical delay between Background and Project Conditions.
[5] Change in critical volume/capacity (V/C).

e. Estimated Intersection Queuing

The effect of project-generated traffic on vehicle queues under 2013 conditions can be estimated by comparing the total design queues from the baseline (i.e. the total number of vehicles regardless of the number of lanes) presented on the TRAFFIX LOS calculation worksheets. However, it is important to note that these estimates are based on substantial changes in traffic volumes over the next eleven years including trip estimates for numerous background projects. Since the green times for individual movements may change during the study time frame, maximum queue estimates may also vary from actual measured lengths under future conditions.

The impact of project traffic on left-turn vehicle queues was evaluated at five intersections serving CMP facilities. These locations were selected based on intersections where the project would add traffic to left-turn movements to and from CMP facilities. Estimated Year 2013 queues with and without the proposed project at each location under each alternative are presented in Table 4.3-10.

The proposed project may increase AM peak hour maximum queues by zero to four vehicles depending on the alternative as compared to Baseline Conditions without the project. Under 2013 PM peak hour conditions, the project is expected to increase queues under Baseline Conditions by zero to nine vehicles depending on the alternative, with the largest increases expected under Alternative 4. The only substantial increases in vehicle queues (i.e. more than one vehicle) under the Preferred Alternative (Alternative 5) are expected to occur in the westbound left-turn movements to southbound Highway 101 at Moffett Boulevard (three vehicle increase) and at Ellis Street (five vehicle increase).

The Moffett Boulevard interchange has yet to be reconstructed, and the north side of the Ellis Street interchange would be modified as part of development already approved under the CUP EA. In addition, the entire interchange may be modified to accommodate bicycle lanes. NASA will work with Caltrans and the appropriate local agencies to identify which, if any, interchange and

mainline improvements would be feasible to mitigate the traffic impacts caused by Alternatives 2 and 4 should either of these project alternatives be implemented.

f. Impacts on the Mathilda Avenue/Highway 237 Interchange

The Mathilda Avenue/Highway 237 interchange and the two adjacent intersections are closely spaced, operate on a single signal controller, and are fully coordinated. Thus, traffic from adjacent upstream and downstream intersections can effect operations at each location. However, the TRAFFIX analysis program used to calculate levels of service does not necessarily accurately represent conditions at this type of interchange because it analyzes intersections independently. The results in Tables 4.3-6 through 4.3-9 indicate that Alternatives 2 through 4 would substantially degrade operations at the Moffett Park Boulevard and Highway 237 westbound ramp intersections on Mathilda Avenue. In an attempt to better estimate future traffic operations, a CORSIM model was developed for the Mathilda Avenue/Highway 237 interchange including the adjacent intersections of Mathilda Avenue/Moffett Park Boulevard and Mathilda Avenue/Ross Drive. CORSIM is a software package developed by the Federal Highway Administration (FHA) that models an integrated network of roadways and/or freeway segments and ramps. The effects of vehicle queuing, merging traffic, and lane changes are just some the operational characteristics modeled by this software.

To be consistent with the TRAFFIX analysis, a model of year 2013 conditions was developed. Traffic signal timings provided by the City of Sunnyvale, in addition to lane configurations and turn pocket lengths, were used as inputs to the CORSIM model. Year 2013 traffic volumes without the proposed project were analyzed first to determine future baseline operations and calibrate the model for future conditions. Traffic volumes were obtained from the *1220 Mathilda Avenue Transportation Impact Analysis* (Draft Report 2, October 30, 2000) published by Meyer, Mohaddes Associates, Inc., and then adjusted to reflect additional traffic growth between 2002 (the horizon year for the Meyer, Mohaddes report) and 2013 (the proposed project's horizon year). The detailed results of the CORSIM model were summarized using a

TABLE 4.3-10 **YEAR 2013 VEHICLE QUEUES WITH AND WITHOUT PROPOSED PROJECT FOR KEY CMP INTERSECTIONS**

		AM Peak Hour		PM Peak Hour	
Left-turn Movement	Alternative	No Project	With Project	No Project	With Project
SB Central Expy to EB Moffett Blvd	2	19	21	13	14
	3	19	21	13	14
	4	19	22	13	15
	5	19	19	13	14
	Mit. 5	19	19	13	14
WB Moffett Blvd to SB Highway 101 On-ramp	2	5	8	13	18
	3	5	7	13	18
	4	5	9	13	22
	5	5	7	13	16
	Mit. 5	5	8	13	14
SB Highway 101 Off-ramp to EB Ellis St	2	10	12	10	11
	3	10	11	10	11
	4	10	12	10	12
	5	10	10	10	11
	Mit. 5	10	10	10	11
WB Ellis St to SB Highway 101 On-ramp	2	3	6	13	20
	3	3	6	13	22
	4	3	7	13	22
	5	3	6	13	18
	Mit. 5	3	7	13	16
SB Mathilda Ave to EB SR 237 On-ramp	2	9	10	15	17
	3	9	9	15	16
	4	9	10	15	18
	5	9	9	15	15
	Mit. 5	9	9	15	15
NB Mathilda Ave to WB Moffett Park Dr	2	35	35	30	30
	3	35	35	30	30
	4	35	36	30	30
	5	35	35	30	30
	Mit. 5	35	35	30	30

post-processor spreadsheet developed by Fehr & Peers Associates, and then used to calculate the LOS for all four intersections. The 2013 AM period was analyzed first since these volumes were substantially higher than the corresponding PM peak period volumes. A CORSIM model of existing conditions was not developed for calibration purposes because the extremely high projected increase in traffic volumes is expected to require a complete modification of the existing signal timing and phasing, even without the project.

The results of this analysis showed that according to the CORSIM model, the facilities were not able to serve all of the projected AM peak hour demand. The model was first analyzed using the minimum pedestrian times for each approach, which resulted in an overall cycle length of 134 seconds. Although pedestrian volumes in this area are relatively low, this would provide a more conservative analysis of traffic operations. Additional runs were completed assuming no pedestrian minimum times and a cycle length of 120 seconds. With either cycle length, the maximum AM peak hour volume that could be served was approximately 75 percent of projected demand, and the corresponding levels of service were not considered accurate. In summary, the existing peak period congestion and lengthy delays at this location are expected to worsen substantially; in addition, the interchange is projected to be over-saturated by 2013 regardless of project implementation unless additional capacity on SR 237 is provided or future traffic demand in the Moffet Park area of Sunnyvale is limited. Thus, the CORSIM analysis could not be used to accurately quantify project impacts at the Mathilda Avenue/SR 237 interchange.

g. Effect of Charleston Avenue Bridge

As noted in the Regulatory Setting section in Chapter 3.3, above, the City of Mountain View and the VTA have expressed interest in the construction of a new roadway connection between Shoreline Boulevard and Moffett Boulevard on the east side of Highway 101. The purpose of this connection would be to provide additional local circulation within and near the City of Mountain View and to provide additional parallel capacity to Highway 101.

The City of Mountain View Year 2010 travel demand model was used to estimate the shift in traffic volumes between Shoreline Boulevard, which serves the North Bayshore area, and Moffett Boulevard, which is the primary access to the Ames Campus. Land uses in the traffic analysis zone (TAZ) representing the existing Moffett/NASA areas (TAZ 125) were modified based on Alternative 4 uses and Alternative 5 (the preferred alternative). Uses were adjusted so that the number of new trips generated by the TAZ generally approximated the number of net new trips estimated using ITE rates. In addition, the highway network was modified to reflect the latest proposed configuration for the Highway 101/Highway 85 interchange. The model was run with this data, and AM and PM peak hour turning movement volumes were obtained at the Moffett Boulevard ramp intersections and at the Shoreline Boulevard/Charleston Road intersection.

The model was run a second time for each alternative with a new, two-lane roadway over Stevens Creek connecting R.T. Jones Road (the Moffett Boulevard Extension) and Charleston Road. The model estimated that the new bridge would serve a daily traffic volume of 11,000 and 8,500 vehicles per day for Alternatives 4 and 5, respectively. These volumes are well within the capacity of a two-lane roadway. Peak hour turning movement volumes were obtained for the intersections under both alternatives to determine the potential effect at intersections.

A review of the LOS calculations for all of the alternatives showed that operations at the Moffett Boulevard ramp intersections would not change substantially with construction of the bridge. Both intersections would operate at essentially the same levels and improvements would still be required at both locations to provide acceptable operations with the proposed project under both alternatives. Based on this impact analysis, it appears that the Charleston Road bridge would provide an alternate path for North Bayshore and Ames Campus traffic, but it is not required to mitigate impacts of the proposed project.

h. Effects on Freeways

Freeway analysis was conducted for both the highway segments close to the Ames Campus, and for those segments located further away or in adjacent counties that would likely serve some project-generated traffic. As noted under the Existing Freeway Analysis Methodology and Operations section (Chapter 3.3, Section C-1.f), some project-generated trips made by employees are expected on highway segments located a substantial distance from the Ames Campus, such as in San Mateo County, Alameda County, distant portions of Santa Clara County and other more distant, outlying counties. Trips made by university students, on-site residents, and museum visitors were assumed to be more local (i.e., mostly within Santa Clara County). As a result, not all project-generated trips were assigned to the furthest freeway segments.

Commuter trips, which represent approximately 40 to 50 percent of the total net new project vehicle trips depending on the peak hour, were distributed to the regional freeway system based on the projected residences of commuters to the Sunnyvale/Mountain View employment superdistrict published by the Metropolitan Transportation Commission (2000). As noted previously, the analysis of potential freeway impacts was identified by determining those segments to which the proposed project would add more than one percent of a segment's capacity. It is important to note that although some study segments operate at LOS D or better under existing conditions, increases in traffic from future regional growth will possibly degrade operations to LOS E or F. The analysis of nearby and external freeway segments for each alternative that includes new construction is summarized in the tables found in Traffic and Circulation Appendix B. A segment is defined as a two-way section of freeway.

The freeway analysis shows that the proposed project would likely significantly affect operations on all segments of Highways 85, 101 and 237 near the project site in at least one direction during the AM and/or PM peak hour. Regardless of the alternative, the proposed project would add traffic volumes that are at least one percent of capacity (and in some cases nearly

eight percent) on all nearby segments (see Tables B-1 through B-4 in Appendix B). Nearby segments were defined as freeway segments within approximately 1.6 kilometers (one mile) of the project site.

Project-generated commute traffic is expected to exceed one percent of the capacity on 16 of the 24 external study segments under Alternatives 2 and 3, 18 segments under Alternative 4, and nine (9) segments under Alternative 5. Overall, project traffic generally represents between 0.1 and 2.5 percent of freeway capacity for most external segments outside a 16-kilometer (10-mile) radius from the project site.

i. Construction Traffic Impacts

Development of the proposed project will require demolition of existing structures, transport of waste, earth, materials, and construction of new buildings and utilities. All of these activities will generate trips by construction vehicles and workers. The vehicles with the greatest impact on peak period traffic operations are trucks because of their slow acceleration, long deceleration, and wide turning radii. These characteristics can reduce the capacity of the adjacent streets if they constitute a significant proportion of traffic.

The construction activity that is expected to generate the highest number of truck trips is the filling of the Bay View area prior to construction of the residential units. The amount of earth needed is expected to generate 12,300 truck loads or 24,600 truck trips over a two- to three-year period. Based on 250 working days per year, this equates to an average of approximately 33 to 49 truck trips per day likely using the Highway 101/Moffett Field interchange. These trips will be distributed throughout the day and are not expected to significantly affect peak period intersection operations at the ramps or on-site.

Buildout of the proposed project is expected to take until 2013. With only approximately 350,000 square feet of building space under construction each year, the number of construction workers is expected to be limited. At any

one time, up to 100 workers are expected to travel to and from the project site during the peak period. This volume of traffic is not expected to significantly affect any of the study intersections, including the intersections of Moffett Boulevard-Clark Memorial Drive at R.T. Jones Road or Ellis Street at Manila Avenue. Based on the limited number of truck trips and construction worker vehicle trips during the peak periods, construction traffic impacts are expected to be less than significant.

2. Effects on Public Transit

The development of a substantial new employment and student base at the Ames Campus would increase the number of potential public transit riders in the study area. The purpose of the proposed aggressive TDM plan is to encourage as many people as possible to use alternatives to single-occupant vehicle trips.

As noted under existing conditions, the level of light rail, bus, and Caltrain shuttle ridership to and from the Ames Campus is high compared to the rest of Santa Clara County, but is relatively low given the capacity of each mode. Less than 300 daily trips are made using all of these modes. VTA light rail service is currently operated on 10-minute headways during the peak periods with trains that have a standing-room only capacity of 160 people per car. Bus service is typically adjusted to accommodate demand, and would be enhanced with increased ridership. Although current demand sometimes exceeds capacity (especially for bicyclists), Caltrain service is constantly being modified and expanded to handle increased demand. As part of the proposed project, the number of vehicles and frequency of the dedicated Caltrain shuttle service would be increased, and an on-site shuttle would include a stop at the light rail station. These services, in addition to provision of transit subsidies (e.g., EcoPass, Commuter Check), would encourage ridership by increasing convenience and reducing costs and travel times.

Although implementation of the project would not conflict with existing or planned public transit facilities and services, implementation of the NADP would generate additional public transit demand. According to the project

trip generation summary, the alternative with the highest level of TDM reduction is Alternative 4. The aggressive TDM program would be expected to provide a reduction of 712 inbound trips in the AM peak hour and 800 outbound trips in the PM peak hour. These trips would be distributed amongst Caltrain, VTA light rail, VTA buses, bicycle facilities, pedestrian facilities, and carpools/vanpools. Even if 50 percent of the PM peak hour trips or 400 trips were made using light rail, for example, this would equate to an average of 66 additional passengers per train, assuming 10-minute headways during peak hours. This load could be accommodated by the existing service or, in the worst-case, would require an additional vehicle. VTA Long-Range Planning staff has indicated that the Tasman West line is designed to accommodate up to three-car trains when ridership increases and an adequate supply of vehicles is available.[2]

Additional demand on buses could be accommodated by the existing service or may require an increase in the frequency of service. The proposed shuttle service to Caltrain will serve some of the TDM demand. Consistent with transportation studies for private development throughout Santa Clara County, the proposed project is being designed to accommodate bus vehicles including through the Town Center traffic circle feature. VTA buses could share proposed shuttle stops within the campus.

Thus, the increased public transit demand generated by the proposed project could be accommodated by the existing and proposed facilities and services, given the multiple public transit opportunities, the existing available capacity, and each transit agency's ability to modify service to accommodate changing demand.

3. Effects on the Bicycle Network

Bicycle travel to and from the Ames Campus using Moffett Boulevard, Ellis Street, and Mathilda Avenue is generally considered difficult because of the

[2] Jim Lightbody, VTA, October 2001.

volume and speed of traffic, potential conflict points (at Moffett Boulevard and Ellis Street), and the lack of designated bicycle lanes or paths. The planned improvements to the Moffett Boulevard/Highway 101 interchange will improve bicycle travel because the elimination of the direct and loop ramps and construction of signalized ramp intersections will require vehicles to reduce their travel speed, and will eliminate weaving sections (where vehicles merge and diverge over a short distance) that are more hazardous for bicycle travel. As part of the interchange upgrade, bicycle lanes will be provided across Highway 101 to the Moffett Boulevard-Clark Memorial Drive/R.T. Jones Road intersection.

The City of Sunnyvale's plan to construct pedestrian/bicycle bridges on Borregas Avenue over Highway 101 and SR 237 to the east, as well as bike lanes on Moffett Park Drive east of Mathilda Avenue, will improve bicycle access to the study area. These facilities will improve access across these freeways and provide an alternative to the congested Mathilda Avenue corridor for bicyclists.

No improvements have been identified for the Ellis Street underpass at the Highway 101 interchange, which creates hazardous conditions for bicycle travel. As currently configured, bicyclists must share travel lanes with vehicles next to large concrete bridge piers because of the adjacent light rail line and limited right-of-way. Implementation of the NADP, with its aggressive TDM plan, would increase the number of bicycle trips through the Ellis Street underpass, subjecting more riders to hazardous travel conditions. A similar conclusion can be reached regarding bicycle travel on Mathilda Avenue, but Ellis Street south of Highway 101 is generally more attractive to bicyclists because of lower traffic volumes; thus, fewer bicyclists would be expected to approach the site from Mathilda Avenue and Moffett Park Drive, which would typically be used by Eastside/Airfield employees only. Once the Borregas Avenue bridges are constructed, bicyclists approaching from the southeast will have another route option to access the site.

On-site bicycle facilities will be extensively improved in the NRP area with the provision of bicycle lanes and multi-use paths. In addition, most streets will be designed to minimize vehicle travel speeds, which enhances bicycle travel. Bicycle parking will be provided at key locations throughout the Research Park (i.e., employment centers) and in the residential developments in Bay View. Secure parking will be provided in addition to bicycle racks, which will be installed near retail and service centers.

4. Effects on Pedestrian Facilities

As noted above, the on-site pedestrian system at the Ames Campus would be improved substantially by the implementation of the NADP. Under all four project alternatives, an extensive network of sidewalks and paths would be constructed to improve safety and accommodate new demand. As part of the project, a new pedestrian path linking the NRP area to the existing Bayshore light rail station would also be constructed.

The number of pedestrians accessing the project site from west of Highway 101 is expected to be very limited because: 1) the existing land uses west of Highway 101 would not generate substantial walk trips to the Ames Campus, and 2) other modes such as light rail transit, bus transit, shuttle service and bicycling will offer better travel opportunities. As described above in relation to bicycle circulation, the reconfiguration of the Moffett Boulevard/Highway 101 interchange will improve pedestrian travel by eliminating the existing direct and loop ramps and constructing signalized ramp intersections. These intersections are expected to include pedestrian signals and activation buttons. Thus, the proposed project is not expected to negatively affect pedestrian travel across Highway 101.

C. Impacts and Mitigation Measures

This section summarizes significant impacts associated with traffic and circulation, and proposes mitigation measures for each identified impact.

Impact CIR-1: Implementation of the proposed project would increase vehicle trips and traffic congestion on segments of Highways 101, 85, and 237 in the immediate vicinity of the Ames Campus, as well as on highway segments outside the local study area. On all nearby segments projected to operate at LOS F, the project would add more than one percent of capacity in at least one direction during the AM and/or PM peak hour. The project is also expected to add more than one percent of capacity to numerous highway segments outside the immediate vicinity of the project in Santa Clara County, as well as on several segments in adjacent counties. Under the Mitigated Alternative 5, the number of segments would be reduced to three.

Applicable to: Alternatives 2 through 5, and Mitigated Alternative 5

Mitigation Measure CIR-1: As part of the NADP, NASA and its partners would implement an aggressive Transportation Demand Management (TDM) program designed to reduce trip generation by a total of at least 22 percent. AVR goals are set for each phase of the TDM plan. Development will not proceed to the next phase until the previous phase's goal has been met. In addition, on-site housing would also help to reduce vehicle trip generation to external streets and freeways by internalizing trips to on-site employment centers and amenities.

To completely mitigate the highway impacts of the proposed project under any of the development alternatives, each highway segment would have to be widened to provide an additional travel lane in at least one direction or other capacity improvements would have to be made. In many cases, widening is infeasible due to right-of-way constraints and the proximity of existing building structures and development. Immediately adjacent to the project site, for example, Highway 101 could not be widened because of the proximity of Manila Drive and the VTA light rail line. In addition, large-scale freeway widening projects are beyond the scope of a single project and could only garner a relatively small fair-share contribution towards the improvement. Therefore, despite the substantial trip reductions from implementation of the TDM program, the increase

in vehicle trips and congestion on the highway system associated with implementation of the NADP would be a significant, unavoidable impact. NASA will work with VTA and Caltrans to consider other mitigations.

Impact CIR-2: The proposed project would increase vehicle trips and traffic congestion at the Moffett Boulevard/Central Expressway and Ellis Street/Manila Drive intersections.

Applicable to: Alternative 2 through 4

Mitigation Measure CIR-2a: *Moffett Boulevard/Central Expressway*. The improvement required to mitigate this impact is the addition of a separate right turn lane from southbound Moffett Boulevard to westbound Central Expressway. This measure would require right-of-way acquisition to implement. The additional lane would improve operations to LOS E during the PM peak hour and would fully mitigate the impact.

Mitigation Measure CIR-2b: *Intersection of Ellis Street/Manila Drive.* Development under the NADP would include the following improvements to achieve acceptable operations and minimize queuing at this intersection:

- Install a traffic signal.
- Provide the following lane configurations:
  - *Northbound (from Highway 101)*: two through lanes and one right-turn lane.
  - *Southbound (from NRP)*: one left-turn lane and two through lanes.
  - *Westbound (from the LRT station)*: one left-turn lane and one shared left-turn/right-turn lane.

This measure would provide LOS C operations during the PM peak hour.

Impact CIR-3: The proposed project would increase vehicle trips and traffic congestion at the intersections of Moffett Boulevard-Clark Memorial Drive/ R.T. Jones Road.

Applicable to: Alternative 2 through 5, and Mitigated Alternative 5

Mitigation Measure CIR-3: *Intersection of Moffett Boulevard/Clark Memorial Drive/R.T. Jones Road.* Development under the NADP would include the following improvements to achieve acceptable operations and minimize queuing at this intersection:

- Installation of a traffic signal.
- Provision of the following lane configurations:
  - *Northbound (from Space Camp/base housing)*: one left-turn lane, one shared through/right-turn lane.
  - *Southbound (from Bay View)*: one left-turn lane, one through lane, and one "free" right-turn lane (i.e., the right-turn movement would not be controlled by the signal and would require a third westbound receiving lane on Moffett Boulevard).
  - *Westbound (from Clark Memorial Drive)*: one left-turn lane, two through lanes, and one right-turn lane.
  - *Eastbound (from Highway 101)*: two left-turn lanes, one through lane, and one shared through/right-turn lane.

This measure would provide LOS C or D operations or better during all periods under all alternatives.

Impact CIR-4: The proposed project would increase vehicle trips and traffic congestion at the following intersections:

Moffett Boulevard/Highway 101 SB ramps

Moffett Boulevard/Highway 101 NB ramps
Central Expressway/Mary Avenue.

Applicable to: Alternative 4

Mitigation Measure CIR-4a: *Moffett Boulevard/Highway 101 SB ramps*. Mitigation of this impact for Alternative 4 would require the addition of a second westbound left-turn lane to southbound Highway 101. The current plans for the interchange modification currently only include a single westbound left-turn lane. This improvement would provide LOS B operations during the PM peak hour. Because of cost, political, and ownership considerations, this mitigation measure is not feasible. Thus this impact would remain significant and unavoidable.

Mitigation Measure CIR-4b: *Moffett Boulevard/Highway 101 NB ramps*. Mitigation for Alternative 4 would require the addition of a second northbound right-turn lane on the off-ramp from U.S. 101. The current plans for the interchange modification currently only include a single northbound right-turn lane towards the project site. This improvement would provide LOS C operations during the AM peak hour. Because of cost, political, and ownership considerations, this mitigation measure is not feasible. Thus this impact would remain significant and unavoidable.

Mitigation Measure CIR-4c: *Central Expressway/Mary Avenue*. Mitigation for Alternative 4 would require the addition of a second southbound right-turn lane to westbound Central Expressway. This improvement would provide LOS E operations during the AM peak hour. However, adjacent existing development and a sidewalk would preclude widening of the roadway. Because of these right-of-way constraints, this mitigation measure is not considered feasible. Thus this impact would remain significant and unavoidable.

Impact CIR-5: Alternatives 2 and 4 would increase vehicle trips and traffic congestion at the following intersections:

Moffett Boulevard/Middlefield Road
SR 237 EB Ramps/Mathilda Avenue
SR 237 WB Ramps/Mathilda Avenue
Moffett Park Drive/Mathilda Avenue

Applicable to: Alternatives 2 through 4

Mitigation Measure CIR-5a: *Moffett Boulevard/Middlefield Road.* To fully mitigate the impacts under both the AM and PM peak hours at this location, a separate right-turn lane from Middlefield Road to northbound Moffett Boulevard would be required. In addition, an overlap signal phase concurrent with the left-turn phase for southbound Moffett Boulevard to eastbound Middlefield Road would be required.

These improvements would provide LOS D operations during both peak hours and would fully mitigate the projected impacts. However, a preliminary field review indicates that this improvement is not feasible due to the proximity of existing development and a sidewalk. Thus, the impact is expected to remain significant and unavoidable.

Mitigation Measure CIR-5b: *SR 237 EB Ramps/Mathilda Avenue*. The addition of any lane capacity at this location would require: complete re-construction of the Highway 101 overpass to widen the road for additional through lanes, non-standard lane configurations such as four left-turn lanes, or provision of another street crossing over SR 237 (e.g., the Mary Avenue overcrossing). Because of cost, political, and ownership considerations, this mitigation measure is not feasible. Thus this impact would remain significant and unavoidable.

Mitigation Measure CIR-5c: *SR 237 WB Ramps/Mathilda Avenue*. Mitigation of this impact would require the addition of a separate southbound right-turn lane from Mathilda Avenue to the on-ramp to westbound SR 237 to provide four exclusive southbound through lanes. Because of cost, political, and ownership considerations, this mitigation

measure is not feasible. Thus this impact would remain significant and unavoidable.

Mitigation Measure CIR-5d: *Moffett Park Drive/Mathilda Avenue.* Mitigation of this impact would require the addition of a second southbound right-turn lane from Moffett Park Drive to westbound Mathilda Avenue towards downtown Sunnyvale. This lane would be in addition to the existing right-turn lane from Moffett Park Drive to westbound Highway 237, but would likely require modification of this already short-radius curve. Because of cost, political, and ownership considerations, this mitigation measure is not feasible. Thus, this impact would remain significant and unavoidable.

Impact CIR-6: The increased level of vehicle and bicycle traffic through the Ellis Street underpass at Highway 101 resulting from the project would increase hazards for bicyclists, who share the standard travel lanes in this location.

Applicable to: Alternatives 2 through 5, and Mitigated Alternative 5

Mitigation Measure CIR-6: Development under the NADP would modify the Ellis Street underpass to better accommodate bicyclists.

One option would be to shift all of the vehicle travel lanes to the north by 4 to 5 meters (12 to 15 feet). Currently, two travel lanes are provided in each direction between three sets of concrete piers. By moving the westbound lane to the north side of the northernmost piers and shifting the other lanes accordingly, additional width could be provided to accommodate bicycle lanes. The northern abutment would have to be rebuilt with a retaining wall similar to the design that was implemented to accommodate the light rail tracks. If this option were implemented, bike lanes would be at least 1.5 meters (5 feet) wide, and adequate signage and lighting would be provided. Figure 4.3-6 illustrates this measure. The feasibility of this improvement would have to be evaluated by a

structural engineer and by Caltrans since the intersection configurations at the two adjacent ramp intersections would have to be modified.

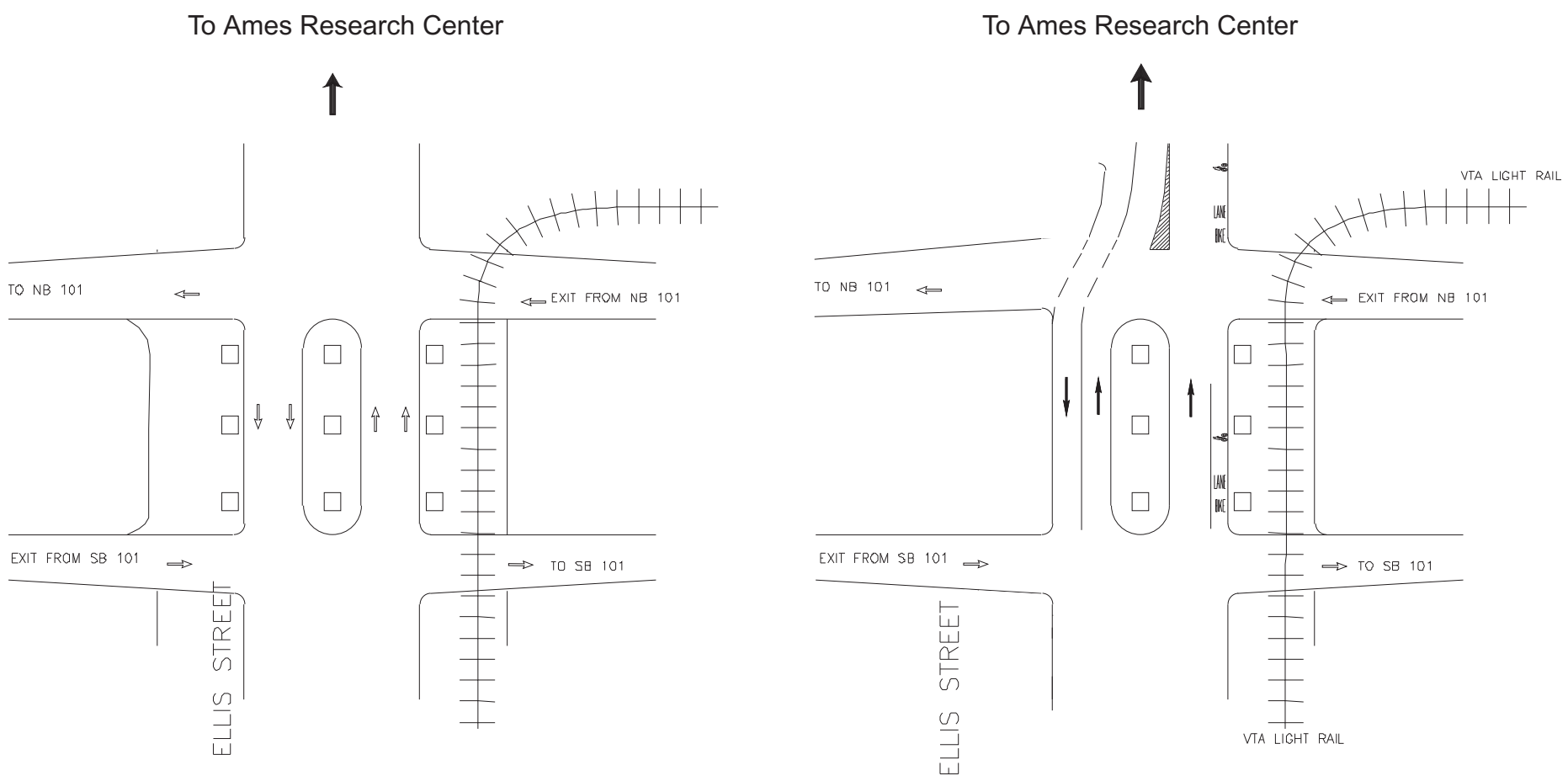
Another option would be modify the intersection to provide reversible 2.4-meter (8-foot) lanes that would allow for two lanes of car traffic and one lane of eastbound bike traffic in the morning and only one lane of car traffic and one lane for bikes in a westbound direction. In the afternoon/evening, the extra lane would provide westbound traffic flows. Again, adequate signage and lighting would be provided.

Implementation of this mitigation measure would reduce the potential impact on bicyclist safety to less-than-significant levels. If this improvement is determined to be infeasible and no alternative is found, then the impact would remain significant and unavoidable.

Impact CIR-7: Construction activity associated with the proposed improvements to facilities within Caltrans right-of-way has the potential to introduce pollutant laden runoff into the storm drain system.

Applicable to: Alternatives 2 through 5, and Mitigated Alternative 5

Mitigation Measure CIR-7: Improvements to facilities within Caltrans right-of-way associated with the development proposed under the NADP shall adhere to the conditions and requirements of Caltrans statewide NPDES Permit CAS #000003, Order #99-06-DWQ and NPDES General Permit CAS #000002, Order #99-08-DWQ, and shall incorporate Best Management Practices described in Section 4.4 of the Storm Water Management Plan which implements the statewide NPDES permit, as such requirements specifically apply to the proposed improvements. In general, this would include the preparation and implementation of a Storm Water Pollution Prevention Plan and Best Management Practices for construction and post-construction conditions for each such project.



Source: Fehr & Peers Associates, Inc.

FIGURE 4.3-6

POTENTIAL ELLIS STREET INTERCHANGE MODIFICATIONS